

Notes on the Biology of the Introduced Elaterid

Conoderus exsul (Sharp)

(Coleoptera: Elateridae)

M. W. STONE

131 Sir Damas Dr., Riverside, California 92507

The Sugarcane wireworm *Conoderus exsul* (Sharp), originally from New Zealand and later Hawaii, was first discovered in 1937 at Alameda, California; currently it is recorded from 14 counties in California. (Stone, 1975). In the Hawaiian Islands the larvae have been found feeding on sugarcane shoots and in Alameda Co., Calif., on grass roots. Larvae of this species made rapid growth when reared in salve cans on wheat. This species could become an important pest of vegetable and field crops with an increase in numbers.

Light trap collections in 1974–75 indicate that *C. exsul* adults have become increasingly abundant in Riverside and Orange counties. This information on seasonal abundance together with preliminary data on the biology of this insect are presented.

CONODERUS EXSUL (SHARP)

Monocrepidius exsul Sharp 1877: 20.

Monocrepidius exsul; Brown 1880. Manual New Zealand Coleoptera I: 294. (copy of Sharp's original description).

Monocrepidius exsul; Sharp 1908. Fauna Hawaiiensis, vol. III, part V: 369 (records it from Hawaii).

Monocrepidius exsul; Williams, 1931: 168. Reports larvae feeding on sugarcane shoots in Hawaii.

Conoderus bicarinatus Van Dyke, 1932: 297. Type male, U.S.A. Arizona, Mt. Washington, near Nogales, 6000', July 8, 1919. (J. A. Kusche) No. 3107, CAS.

Monocrepidius exsul; Graves, 1938: 91. Larvae and adults collected at Alameda, Cal. Det. by Van Dyke.

Conoderus arizonicus Van Dyke, 1939: 11. New name for *C. bicarinatus* Van Dyke (nec Reitter, 1891).

Conoderus duplicatus Van Dyke, 1943: 44. Unnecessary new name for *C. bicarinatus* Van Dyke (nec Reitter, 1891).

Conoderus exsul; Lane, 1954: 246. Report on distribution in Calif.

Conoderus exsul; Stone, 1975: 165. Widespread in central and southern Calif.

Conoderus bicarinatus Van Dyke appears to be a synonym of *exsul*. Becker, E. C. (personal comm.) examined the type of *exsul* and it compared favorably with California specimens. Adults collected throughout California, Arizona, and also in Hawaii have been found to be similar to the holotype of *bicarinatus* Van Dyke (No. 3107 CAS). The Van

Dyke description of this species appears adequate. Additional notes and measurements on both sexes follow.

MALE.—Length 8.5 to 12 mm. width 2.6 to 3.2 mm. Antenna slender and thread-like extending $\frac{1}{2}$ to 1 segment beyond apex of hind angles of pronotum. Segments 2 to 5 with following lengths in mm.; .17, .25, .46, .46. Male genitalia (Fig. 6)

FEMALE.—(Figs. 4 & 5). Length 11 to 13 mm.; width 3.8 to 4 mm. More robust and larger than male. Antenna shorter extending to apex of hind angle of pronotum.

BIOLOGICAL AND MORPHOLOGICAL NOTES

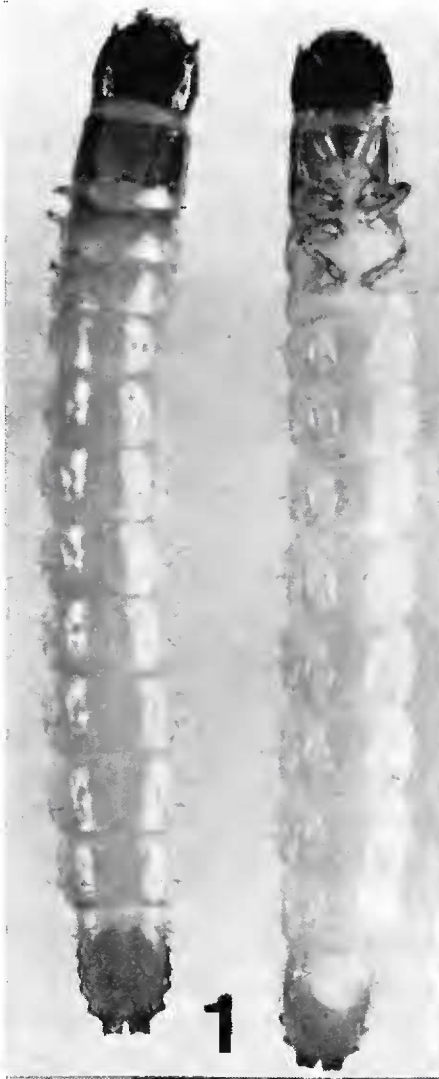
Egg.—The egg is whitish, smooth, oval shaped and measures 0.43 by 0.53 mm. Newly deposited eggs have a sticky coating which cause soil particles to adhere, making the eggs difficult to locate in the soil. Adults obtained at black light and confined indoors in 2 oz. soil-filled, salve cans laid eggs from June to early September. A total of 218 eggs were obtained from one large reared female.

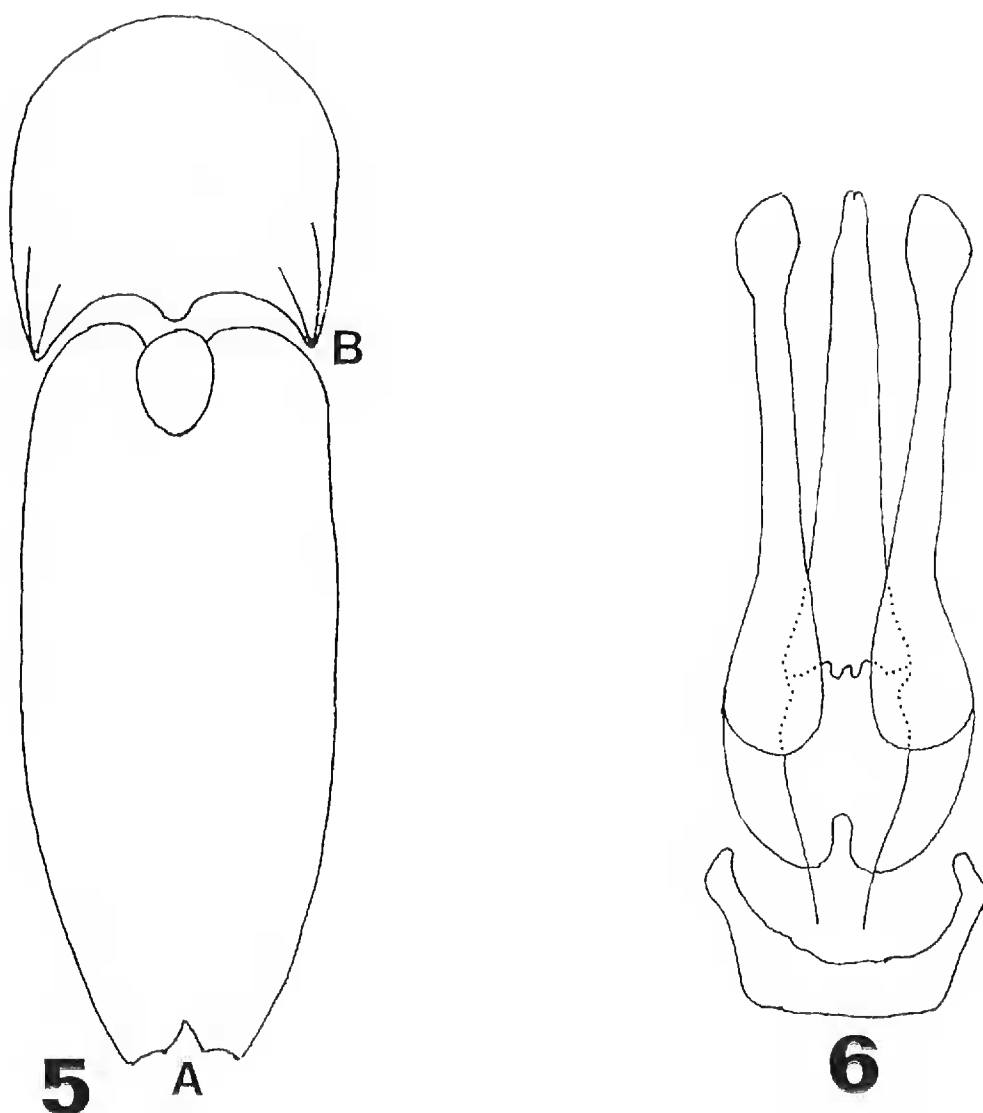
Larva.—(Fig. 1). The newly hatched larvae are whitish, but become cream colored after the second moult. When mature the head, thorax and terminal lobes of the ninth abdominal segment are dark reddish. The caudal notch on the ninth segment is nearly closed on immature larvae but gradually enlarges and is V shaped on mature larvae (Fig. 2). Full grown larvae measure 15 to 19 mm. long by 2.2 to 2.8 mm. wide.

Pupa.—(Fig. 3). When first formed the pupa is opaque white, but later becomes cream colored and the eyes become conspicuous as dark spots. Mouth parts, antenna, wing pads and legs are all visible. A sharp spine is present near each anterior margin of the pronotum and a similar spine is also present at each posterior angle. Two stout shorter spines are located at the tip of the abdomen. Pupae vary greatly in size: 8 to 14 mm. long by 2.5 to 3.4 mm. wide.

The duration of the larval period of *Conoderus exsul* was determined by confining newly hatched larvae individually in 2 oz. salve tins containing moist 30 mesh soil and wheat, which were replenished at 2 week intervals. The larvae were confined indoors at temperatures of 15–25° C (60 to 78° F). Of a group of 34 larvae which hatched during August 1974, 5 pupated in March 1975, 11 in April, 10 in May and 8 in June–July 1975. The wide range in the duration of the larval period, from 8 to 12 months, is difficult to explain since the larvae, depending on size, were fed equal amounts—2 to 5 kernels of wheat at each feeding. The first adult was obtained on March 20, 1975 or 2.7 months before adults were collected at light outdoors. The pupal period for 29 individuals ranged from 14 to 18 days, an average of 15.7 days. Adult longevity varied depending upon temperature, moisture and food availability. When confined in glass jars indoors with moistened cotton and slices of carrot adult life ranges from 25 to 65 days, averaging 38 days.

In 1975 rearings of *C. exsul* were conducted to determine if the dura-





FIGS. 5-6. *Conoderus exsul* Sharp. Fig. 5. Body outline A. Apices of elytra with rounded notches; found only in *C. scissus* Schfr. B. Unusual in that the hind angles of the prothorax have paired carina. Fig. 6. Male genitalia (Ventral view) $\times 75$.

tion of the larval period varied according to the time at which the egg hatched. Larvae hatching on June 15 and from August 15 to September 15 were reared indoors in containers on wheat as previously described. In the above two groups designated as early (June 15) and late (August 15 to September 15) hatch, 15.8% and 12% of the larvae matured the same year. The larval period in these groups ranged from 54 to 103 days. The pupal period averaged 14 days. (Table 1). In the early

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FIGS. 1-4. *Conoderus exsul* Sharp. Fig. 1. Larva, dorsal and ventral view, $\times 6$. Fig. 2. Larva, ninth abdominal segment, dorsal view. Fig. 3. Pupa, ventral view, $\times 8$. Fig. 4. Adult, female, $\times 7$.

TABLE 1. Duration of larval stage of *Conoderus exsul* Sharp. Riverside, Cal. 1975-76.

Date hatched 1975	Records (No.)	Pupa- tions (%)	Larvae completing development in				
			1975		Pupations (%)	1976	
			Range (Days)	Ave. (Days)		Range (Days)	Ave. (Days)
June 15	38	15.8	81-103	91	84.2	218-292	251
Aug. 15 to Sept. 15	24	12.5	54-78	62	87.5	180-214	214

hatch overwintering group, pupations began January 22 and terminated April 1, 1976. First and last adults were obtained on February 8 and April 20.

In the late hatch overwintering larval group, the first pupation occurred a month later on February 21 and the last April 23. The above pupae transformed to adults March 12 and May 11. There was not much difference in the duration of the larval period in the early and late hatch groups, as indicated by the averages, 251 and 214 days, respectively. The same was true of the pupal period for both groups, which ranged from 17 to 23 and averaged 19 days. (Table 2).

One would expect that the higher temperatures indoors would be responsible for accelerating larval feeding and for their reaching maturity abnormally early. Nevertheless, it is interesting to note that of 10 medium size larvae dug up outdoors in January and fed lima beans, all pupated in February and March, as was the case with specimens in the containers kept indoors.

Information obtained to date indicates that in the presence of ample

TABLE 2. Duration of the pupal period of *Conoderus exsul*. Riverside, Cal. 1975-76.

Date hatched 1975	Larvae completing development in			
	1975		1976	
	Range (Days)	Ave. (Days)	Range (Days)	Ave. (Days)
June 15	12-16	14	18-23	19.4
Aug. 15 to Sept. 15	14-15	14	17-20	18.6

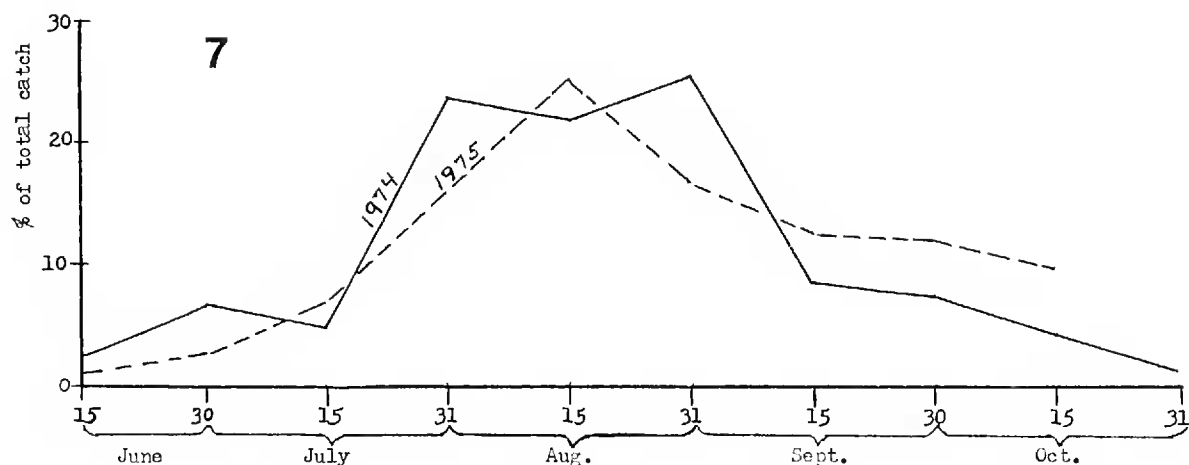


FIG. 7. Bimonthly catches of *Conoderus exsul* adults at black light. Riverside, Calif. 1974-75.

food a small percentage of *C. exsul* larvae mature the same season, whereas the majority complete their life cycle in the year following.

PHENOLOGY

At Riverside adults were collected nightly at a 15 Watt florescent black light located adjacent to a bare field formerly planted to citrus. J. Wilcox employed a similar trap set-up in an avocado grove located 4 miles east of Olive, CA. (Orange County), about 30 miles from Riverside.

In 1974 at Riverside, adults were first collected on June 14 and were most numerous in the period July 31 to Aug. 31. Emergence terminated on Oct. 17. Trapping at Olive was started later—on Aug. 2—and terminated Oct. 22, yielding a total of 518 adults. At Riverside 286 adults were collected over a much longer period. Peak emergence at Olive occurred in the period Aug. 31 to Sept. 15.

In 1975 at Riverside the first adult was collected at light on June 11. The largest numbers of adults were obtained when outdoor temperatures at 8 to 9 p.m. remained at 24 to 26° C (75 to 80° F), usually after daytime temperatures reached maximums of 35 to 38° C (95 to 100° F). No adults were collected when evening temperatures dropped to below 15° C (60° F). Peak emergence in 1975 occurred in the period Aug. 1 to 31, the same period as in 1974. Adult activity ceased on Oct. 6. A total of 211 adults were collected, with males and females in equal numbers. Fig. 7 shows catches of adults bi-monthly at Riverside in 1974-75.

At Olive in 1975 (fig. 8) adults were first collected on June 26 and terminated Nov. 2. The peak of collections occurred Sept. 1 to 15. A total of 1238 adults were taken—an exceptional number for an intro-

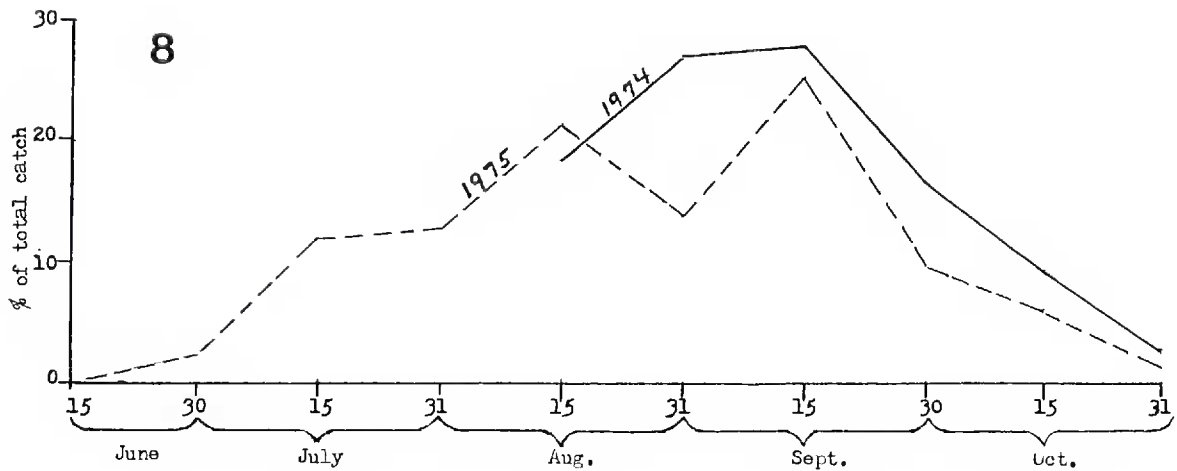


FIG. 8. Bimonthly catches of *Conoderus exsul* adults at black light. Olive, Calif. 1974-75.

duced species, considering that the soil in this grove was of coarse texture, not overly moist and generally unfavorable for wireworm survival. Of the total catch 48% were females.

ACKNOWLEDGMENTS

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